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# *The University of North Carolina*

# THE RECORD

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CHAPEL HILL

# DEPARTMENT OF APPLIED SCIENCES.

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## FACULTY.

FRANCIS PRESTON VENABLE, PH.D., LL.D., D.SC., PRESIDENT, *Professor of Theoretical Chemistry.*

JOSHUA WALKER GORE, C.E., DEAN, *Professor of Physics.*

JOSEPH AUSTIN HOLMES, S.B., STATE GEOLOGIST, *Lecturer on the Geology of North Carolina.*

WILLIAM CAIN, C.E., *Professor of Mathematics.*

COLLIER COBB, A.M., *Professor of Geology and Mineralogy.*

CHARLES HOLMES HERTY, PH.D., *Smith Professor of General and Industrial Chemistry.*

JOSEPH HYDE PRATT, PH.D., *Professor of Economic Geology.*

ALVIN SAWYER WHEELER, PH.D., *Associate Professor of Organic Chemistry.*

ARCHIBALD HENDERSON, PH.D., *Associate Professor of Mathematics.*

JAMES EDWARD LATTA, A.M., *Associate Professor of Physics.*

JAMES EDWARD MILLS, PH.D., *Associate Professor of Chemistry.*

MARVIN HENDRIX STACY, A.M., *Instructor in Mathematics.*

ROYALL OSCAR EUGENE DAVIS, PH.D., *Instructor in Chemistry.*

NATHANIEL CORTLANDT CURTIS, PH.B., B.S., *Instructor in Drawing.*

ALBERT WHITEHEAD LATTA, PH.B., *Assistant in Physics.*

WILLIAMS McKIM MARRIOTT, S.B., *Assistant in Chemistry.*

WADE HAMPTON OLDHAM, *Assistant in Chemistry.*

EDGAR EUGENE RANDOLPH, A.B., *Assistant in Chemistry.*

ROBERT GILLIAM LASSITER, *Assistant in Field Geology.*

GEORGE MALLETT MACNIDER, *Assistant in Geology.*

REX WILLIAM PERRY, *Assistant in Geology.*

## COURSES.

The Department of Applied Sciences includes four special courses of study:

I. Chemistry.
II. Electricity.
III. Civil Engineering.
IV. Mining and Metallurgy.

Each course offers instruction in certain sciences and their application to the arts, with certain other general studies deemed essential for a liberal education. The freshman year is practically the same in all courses, giving a foundation for scientific study.

These courses are designed to furnish the fundamental instruction and prepare students to pursue the technical professions to which they lead.

## ENTRANCE REQUIREMENTS.

1. History. History of the United States, and either the History of England, or the History of Greece and Rome.
2. English. English Language and Literature requirements of the Association of Southern Colleges. See general Catalogue, page 23.
3. Mathematics. Arithmetic, High School Algebra and College Algebra to Quadratic Equations, and three books of Plane Geometry (five books to be required after 1906).
4. Physics. An Elementary course such as is contained in Carhart and Chute's High School Physics or its equivalent.
5. German. A thorough knowledge of the inflections, including the most common strong verbs; acquaintance with the ordinary laws of syntax; 150 duodecimo pages of ordinary modern German prose; ability to translate into German simple sentences.
6. French. Similar to the requirements for German, save that the applicant should have read 200 duodecimo pages of ordinary modern French prose.

When applicants have had no preparation in Physics or in German or in French, the requirement may be satisfied by pursuing the corresponding courses in College. But these will not then be counted as any part of the requirement for the bachelor's degree.

## SCHEDULE OF COURSES.

### I. Chemistry.

#### FRESHMAN YEAR.*

English 1 (3); Mathematics 1 (4); German 2 (3) or French 2 (3); and six hours from the following: Spanish 1 (3); History 1 (3); Geology 1 (3).

#### SOPHOMORE YEAR.

English 2 (3); Mathematics 2 (3); Chemistry 1 (3); Chemistry 3 (2); Physics 1 (3); German (3) or French (3).

The Modern Language selected must be German, unless German 2 was elected in the Freshman year.

#### JUNIOR YEAR.

English 3A (2); Chemistry 2 (3); Chemistry 4 (3); Chemistry 5 (5); Drawing 1 (2).

#### SENIOR YEAR.

Chemistry 6 (2); Chemistry 7 (3); Chemistry 8 (5); Geology 2 (2); Physics 6 (fall term) (3); Economics or History (2).

### II. Electricity.

#### FRESHMAN YEAR.

(Same as Freshman Year Course I.)

*Completion of Group 1 or Group 2, Freshman year, outlined in General Catalogue, Academic Department, will be accepted as an equivalent.

SOPHOMORE YEAR.

English 2 (3); Mathematics 2 (3); Chemistry 1 (3); Chemistry 3 (2); Physics 1 (3); Drawing 1 (2).

JUNIOR YEAR.

English 3A (2); Mathematics 3 (3); Physics 4 (3); Chemistry 2 (3); Drawing 2 (2); Mathematics 4 (3) or Chemistry 4 (3).

SENIOR YEAR.

Physics 6 (3); Physics 7 (4); Physics 8 and 9 (2); English 4 (3); Mathematics 7 (3) or Chemistry 7 (3).

## III. Civil Engineering.

FRESHMAN YEAR.

(Same as Freshman Year Course I.)

SOPHOMORE YEAR.

English 2 (3); Mathematics 2 (3); Chemistry 1 (3); Physics 1 (3); Drawing 1 (2).

JUNIOR YEAR.

English 3A (2); Mathematics 3B (2); Mathematics 4 (3); Geology 3 (3); Mathematics 7 (3); Drawing 2 (2).

SENIOR YEAR.

Mathematics 7A (3); Mathematics 8 (2); Mathematics 10 (3); English 4 (3); Elective (3).

## IV. Mining and Metallurgy.

FRESHMAN YEAR.

(Same as Freshman Year Course I.)

### SOPHOMORE YEAR.

English 2 (3); Mathematics 2 (3); Chemistry 1 (3); Chemistry 3 (2); Geology 3 (3); Drawing 1 (2).

### JUNIOR YEAR.

English 3A (2); Mathematics 3 (3); Mathematics 4 (3); Chemistry 2 (3); Physics 1 (3); Geology 2 (2); Ore Deposits (24 lectures).

### SENIOR YEAR.

English 4 (3); Mathematics 7 (3); Chemistry 4 (3); Physics 4 (3); Geology 4 (3); Drawing 2 (2); Mining (10 lectures).

## DEGREE.

Each of these courses leads to the degree of Bachelor of Science (B.S.), and a special certificate will be given on the completion of any one of them.

## EXPENSES.

The charges for each of the two terms are as follows:

| | |
|---|---|
| Tuition fee | $30.00 |
| Registration fee | 5.00 |
| Medical and Infirmary fee | 3.00 |
| Gymnasium fee | 2.00 |
| Library fee | 2.00 |
| | $42.00 |

# SUBJECTS OF INSTRUCTION.

## CHEMISTRY.

Professor HERTY.

1. General Descriptive Chemistry. Lectures with laboratory work. A study of the elements and their compounds, including an introduction to organic Chemistry. *Three hours.*

2. Technical Chemistry.

(*a*) Industrial and Agricultural Chemistry. Glass-making, acids, alkalies, phosphates, fertilizers, foods, clothing, hygiene, etc. *Three hours* (*fall term*).

(*b*) Metallurgy. Mining, treatment of ores, smelting, chlorination, fuel, building materials, etc. *Three hours* (*spring term*).

Prerequisite: Chemistry 1.

Associate Professor WHEELER, Mr. MARRIOTT and MR. RANDOLPH.

3. Qualitative Analysis. Laboratory work with lectures. *Two hours.*

May be taken with Chemistry 1.

Associate Professor MILLS.

4. Quantitative Analysis and Assaying. Laboratory work, lectures and stoichiometric exercises. A grounding in analytical methods. *Three hours.*

Prerequisite: Chemistry 1 and 3.

Associate Professor WHEELER.

5. Organic Chemistry. Lectures. *Two hours.* Laboratory work. *One or three hours.*

One or two hours may be devoted to experimental work in some special group, as the cellulose, the terpene, the pyridine, or the alkaloid.

May be taken with Chemistry 4. Prerequisite: Chemistry 1 and 3.

Professor VENABLE.

6. The Theories of Chemistry. Lectures. *Two hours.*

Prerequisite: Chemistry 1, 3, 4, and 5.

Dr. DAVIS.

7. Physical and Electro-Chemistry. Lectures and text-books, with laboratory work. Application of electricity to chemical processes. *Three hours.*

May be taken with Chemistry 8. Prerequisite: Chemistry 1–6 inclusive.

Professor HERTY.

8. Quantitative Analysis. Laboratory work. Gas analysis and extension of course 4 in technical lines. Bacteriological examination of water (with Professor Manning). Research. *Five hours.*

Prerequisite: Chemistry 1, 3 and 4.

A certificate is granted to a student who has completed all the above courses, except course 7, and has submitted a thesis uponsome research successfully carried out in the laboratory.

The Journal Club meets once a week. The current journals, American, English, German and French, both the purely scientific and the technical, are reviewed by the students and instructors. Attendance is required of students in all courses except 1 and 3.

For courses 9 and 10, see *Department of Medicine* and *Department of Pharmacy.*

Professor HERTY.

11. Research in Inorganic and Analytical Chemistry. *Six hours.*

This course (with 12 and 13) is intended only for applicants for the degree of Doctor of Philosophy, or properly equipped students who desire special training in advanced chemical research. It requires, in addition to the laboratory work, daily conferences with the professor and continual reference to the literature touching the matter under investigation, The work is usually assigned by the professor, but by special permit, the student may elect to work upon problems to which he wishes to give particular attention.

Associate Professor WHEELER.

12. Research work in Organic Chemistry. *Six hours.*

Many lines of investigation are open in the cellulose field and other departments of Organic Chemistry. Investigations which have a bearing upon physiology may be undertaken, or the student may be guided in work of his own selection.

Associate Professor MILLS.

13. Research in Physical Chemistry. *Six hours.*

Acquaintance with the Calculus is required for this course.

Professor HERTY.

14. Advanced Inorganic Chemistry. *Two hours.*

The elements are studied with the idea of showing the fundamental laws of Chemistry and the deep-seated relations involved in and leading up to the Periodic System. Attention is also given to those portions of Inorganic Chemistry not usually dwelt upon in the regular courses. The applications of physico-chemical laws and generalizations are emphasized throughout the course.

Associate Professor WHEELER.

15. Lectures and Seminary work in special chapters of Organic Chemistry. *Two hours.*

The *Journal Club* meets every other Monday evening for an hour. The current journals, American, English, German, and French, purely scientific and technical, are reviewed by the students and instructors. At stated periods special subjects are assigned and reported on at subsequent meetings. Attendance upon the meetings of the Club is required of all students taking the above courses.

## PHYSICS.

Professor GORE.

1. General Physics. Lectures with text-book. Laboratory and problem work. *Three hours.*

Preparation required: Mathematics 1.

2. Physics. Mechanics: Solids, Liquids and Gases. Lectures, recitations and problem work. *Two hours (fall term).*

Preparation required: Physics 1 and Mathematics 2.

3. Physics. Heat and Light. Lectures, recitations and problem work. *Two hours (spring term).*

Preparation required: Physics 1 and Mathematics 2.

4. Physics. A general study of Electricity and Magnetism, with laboratory work. Direct current dynamos and motors, with testing and study of typical forms in the laboratory. *Three hours.*

Preparation required: Physics 1 and Mathematics 2.

5. Physics. Descriptive Astronomy. A general course. Lectures with text-book. Observations with telescope. *Two hours.*

Preparation required: Physics 1 and Mathematics 2.

Associate Professor LATTA.

6. Thermodynamics. This course is intended for students who have taken Mathematics 2 or its equivalent, and are familiar with the elementary facts and principles of Heat. The texts used are Edser's "Heat for Advanced Students", and Ewing's "The Steam Engine and Other Heat Engines". These are supplemented with lectures and problem work. The course undertakes to give familiarity with the two fundamental laws of thermodynamics, and with their application to problems involving heat and mechanical energy. Such subjects as the following are studied: The specific heats of gases at constant pressure and at constant volume; Kelvin's absolute scale of temperature; the physical properties of gases and saturated vapors; the theory of heat engines; the theory of refrigerating machines; the transmission of power by compressed air. *Three hours.*

7. Alternating Currents and Alternating Current Machinery. This course is open to students who have taken Mathematics 2, and Physics 1 and 4. Those who take the course are expected to read Franklin and Williamson's *Alternating Currents.* The class-room work, however, consists mainly of lectures on the theory and use of alternating currents of electricity. From five to eight hours of each week are spent in the laboratory, which is equipped with an alternating current dynamo belted to a continuous current motor, a rotary converter, a single phase induction motor, a three phase induction motor, a 10,000-volt testing set, a synchroscope, a set of transformers including both the shell and the core types, a friction brake, and a liberal supply of condensers, voltmeters, ammeters, wattmeters and other apparatus. The student is given practice in dealing with circuits containing inductance and capacity, in making various transformer connections, and in running tests on generators, motors and transformers. *Four hours.*

8. Primary and Secondary Batteries. Course 8 is arranged for students who desire an elementary but thoroughly modern and practical

treatment of the galvanic cell and the storage battery. The theory of the primary cell is first studied, laws for the calculation of electromotive force developed and the characteristics of modern types considered. The study of the storage battery follows; and some of the subjects considered are: The fundamental equation of the storage cell; the relative advantages of the Plante and Faure types; the best rates of charge and discharge; care and management of secondary batteries; engineering uses of the storage battery, etc. *Two hours (fall term).*

The course is open to students who have taken Physics 1 and Chemistry 1.

9. Electric Wiring and Lighting. In this course electric lamps are tested, circuits for different kinds of service calculated, and various switchboard and transformer connections studied. *Two hours (spring term).*

Course 9 is open to students who are taking or have already taken course 7.

## MATHEMATICS.

Associate Professor HENDERSON and Mr. STACY.

1. Algebra, from Quadratics to Determinants (Wentworth's *College Algebra*). Geometry from Book IV. through Solid Geometry (Wells' *Essentials*). Plane Trigonometry and Logarithms (Ashton and Marsh). *Four hours.*

Professor CAIN.

2. Brief Course in Conic Sections (Ashton's *Analytic Geometry*). Elementary Course in Differential and Integral Calculus. *Three hours.*

Associate Professor HENDERSON.

3. (*a*) Elementary Mechanics. Special stress is laid upon clear, convincing treatment and upon the working of examples.

   (*b*) Surveying. Land, topographical, city and railroad surveying with the constant use of compass, level and transit in the field and the making of maps, profiles and topographical sketches in the drawing room. *Three hours.*

   Prerequisite: Mathematics 1.

Mr. Curtis.

3B. Graphics (Descriptive Geometry, Shades, Shadows and Perspective). In this course the mathematical theory and problems involved are required of the students in addition to neat drawings of the leading constructions. *Two hours.*

Professor Cain.

4. Differential and Integral Calculus (Gibson). The treatment of curves, maxima and minima, areas, volumes, and centres of mass and inertia receive special attention. *Three hours.*
Prerequisite: Mathematics 2 (*fall term*).

5. Burnside and Panton's Theory of Equations. *Three hours.*
Prerequisite: Mathematics 4.

Associate Professor Henderson.

6. Differential Equations (Murray). *Three hours.*
Prerequisite: Mathematics 4.

7. Analytic Mechanics (Bowser). The Calculus is applied here freely to theorems and problems in Statics, Kinematics and Kinetics. *Three hours.*
Prerequisite: Mathematics 3 and 4.

7A. Hydraulics (Merriman). Includes the principles of hydraulics and flow of water in canals, rivers, through pipes and orifices and over weirs. Hydraulic motors and water wheels. *Three hours.*
Prerequisite: Mathematics 7.

Professor Cain.

8. Mechanics of Materials, Stresses in Structures. The resistance and elasticity of materials, the designing of cylinders, riveted joints, cantilever and simple beams, restrained and continuous beams, strength of columns and of shafts and combined stresses in beams, etc. Maximum stresses in roofs and bridges. *Three hours.*

10. (*a*) Graphical Statics. Analysis of roof stresses after the graphical method; the application of the theory of the equilibrium polygon to arches of every kind; stone, brick, concrete or reinforced concrete.

(*b*) Higher Surveying. Theory of railroad curves and location; side staking and computation of earth-work; sewer lines and incidental problems in construction. *Three hours.*

Prerequisite: Mathematics 3 and 8.

Associate Professor HENDERSON.

12. Projective Geometry (Reye). *Two hours.*

13. Solid Analytical Geometry (Smith, Salmon, Fort). *Two hours.*

Professor CAIN.

15. Differential and Integral Calculus (Byerly, Edwards). Lectures. *Two hours.*

## GEOLOGY AND MINERALOGY.

Professor COBB, Mr. LASSITER, Mr. MACNIDER, Mr. PERRY.

1. Elementary Geology. Lectures, laboratory and field work. The reading follows LeConte's Elements. Dana's Manual and Geikie's Text-book are used as references. The laboratory work consists of a study of common minerals and rocks and of geological structures and phenomena. In the field-work actual geological structures and phenomena are investigated. *Three hours.*

2. Mineralogy. Sixteen lectures (eight in the fall and eight in the spring term). Determination of minerals by physical properties with confirmatory blow-pipe tests; chemical properties of minerals and chemical methods of determination. Four field trips are made. *Two hours.*

3. General Critical Geology. History and development of the science. Certain phenomena studied in the field. Study of one or more representatives of each class of living vertebrates. Historical geology. Characteristic rocks and the type fossils of each period studied in laboratory. Special study by each student of the structural features or economic resources of a district or the development of some organic type. Lyell's Elements of Geology is used, with references to Lyell's Principles, Zettel's History and Palaeontology and periodic literature of the science. Theses required. *Three hours.*

4. Economic Geology. Lectures, supplemented by reports upon special investigations. Ore deposits and economic minerals. Field-work in the neighborhood of Chapel Hill, longer trips made on Thanksgiving and Easter. The longer trips for 1905–06 will be to the Virginia Copper District and to the Cumnock Coal Fields. Theses required. *Three hours.*

5. Petrography. Lectures, laboratory work, theses. *Two hours.*

6. Advanced field work and special research in geology or geography. Problems assigned individually and work adapted to the professional needs of the student. *Three hours.*

7. Research course in historical geology. *Three hours.*

8. Origin and Nature of Soils. Field work, laboratory work and theses. *Three hours (spring term).*

Professor HOLMES.

9. Economic Geology of North Carolina. In these lectures the economic geology of other portions of the Southern Appalachian region is also discussed.

10. Mining in the Southern Appalachian Region. These lectures include a discussion of gold, silver, coal, and iron mining.

As supplementary to courses 9 and 10 students are expected to visit the mining regions described.

Professor PRATT.

11. Mineral and Ore Deposits. Lectures supplemented by laboratory and field work. *Twenty-four lectures (spring term).*

12. Principles and Practice in General Mining. Lectures supplemented by visits to different mining regions.

Professor COBB.

13. Advanced Geological Field-Work and Special Research. Study of the Deep River area of the Newark rocks. A brief examination of the Potomac, Eocene, Lafayette, and Columbia deposits. *Three hours (one term).*

This course is given in the summer. It covers five weeks, of which one is spent in Chapel Hill with daily meetings; the remaining four weeks are devoted to field-work. Students who take this course will be expected to devote all their time to it.

## DRAWING.

Mr. Curtis.

1. Drawing (Freehand). Simple geometric figures, vases, and common objects; drawing from the cast in charcoal and pencil; pen and ink and simple wash drawings. Systematic instruction is given, and effort is made to cultivate correct observation and feeling for form structure. The simplest and most direct methods are taught. *Four hours, counting as two.*

2. Drawing (Mechanical). The care and use of drawing materials and instruments. Geometrical problems classified and varied, leading up to the making of mechanical drawings. Lettering, mechanical and freehand; construction of scales; tinting; brush and pen shading; problems in shades and shadows, and descriptive geometry. *Four hours, counting as two.*

3. Advanced Mechanical Drawing. Working drawings; tracings; blue printing; isometric drawing; perspective; intersections; topographical. *Three hours.*

4. Architecture. Architectural History: Egyptian, Greek, Roman, Mediæval, and Renaissance. Elements of architecture. The Orders.

# LABORATORIES AND MUSEUMS.

## THE CHEMICAL LABORATORY.

The Legislature of 1905 appropriated $45,000 for the construction of a new chemical laboratory. Every effort will be made to complete this building in time for the session of 1905–06. It is practically a three-story building with a lecture room annex There are 25,000 square feet of floor space. The laboratory has been carefully planned for the accommodation of all branches of chemical work and for the highest possible efficiency. The ground floor will contain store-rooms, work shop, photographic rooms, technical laboratory, and rooms for physical chemistry where equable temperature and solid foundations are needed. The second floor has the organic laboratory, quantitative rooms, library, another technical laboratory, main lecture rooms, museum, offices, etc. The third floor provides for qualitative analysis, general experimental work, medical and pharmaceutical chemistry, physiological chemistry, physical chemistry, research rooms, and a small lecture room. Good light and ventilation are provided for. The building is of pressed brick with stone facings. The value of the equipment in the building will be from $15,000 to $20,000. The chemical library has a special endowment of $5,000. It contains at present about 1,000 volumes.

## THE PHYSICAL LABORATORY.

The Physical Laboratory occupies the eastern half of the main floor and almost the whole of the basement floor of the Alumni Building, amounting to about 7,000 square feet of floor space.

The main floor is divided into a lecture room, and apparatus room, laboratory for students in the general course, Physics 1, and a laboratory for X-ray and photometric work.

In the rooms of the basement are located the dynamos, motors, electrical laboratory, electric furnaces, storage battery, and the workshops for wood and metal.

A special appropriation, granted by the Legislature in 1903, has made it possible to equip the Physical Laboratory with standard types of electrical machines: dynamos, motors, transformers, meters, switchboard, storage battery, electric furnace, and the accessories needed for practical instruction in electrical engineering. The facilities for the general teaching of Physics experimentally have likewise been increased.

The electric light and central heating plants constitute valuable adjuncts to the laboratory.

## THE GEOLOGICAL LABORATORY AND MUSEUM.

The Geological Laboratory occupies the first floor of the New East Building. In addition to a lecture room with a seating capacity of about ninety, there is a laboratory supplied with working collections of minerals, rocks, and fossils, and with photographs, maps, and models illustrating geological structure. The laboratory is furnished with two petrographical microscopes, and with apparatus for the slicing and polishing of rocks. Microscopic slides have been made of most of the specimens from North Carolina; and the department has, also, sections of the typical European rocks. Sections of the rocks around Chapel Hill, and the igneous rocks of the Boston Basin, made by the late Hunter Lee Harris, of the class of 1889, were given to the geological department. A room for photographic work has recently been added.

The University possesses a collection of more than two thousand specimens of typical rocks and minerals from various European localities, and of large specimens of building stones, coals, and various products illustrating the economic geology of the State. These are arranged in an exhibition room of six hundred and fifty square feet of floor space. Here are kept also the sections taken with a diamond drill in the coal regions of Pennsylvania, in the region around King's Mountain, where the Summer School of Geology held its sessions, in the Dan River coal fields and in the Triassic Rocks at Durham, N. C. A complete set of the ores of the precious metals found along the line of the Atchison, Topeka, and Santa

Fé Railroad is included in the collection. Valuable additions have been made to the collections of fossils also, affording increased opportunity for laboratory work in historical geology and palæontology. The collection illustrating economic geology has been largely increased.

The department library, which occupies a room adjoining the exhibition room, is supplied with State and United States Reports, the papers of working geologists, the best works upon Geology, and scientific periodicals.

## THE DRAWING ROOM.

An excellent room, with sky-lights, has been provided for drawing. It is furnished with the most approved tables and drawing boards. Students furnish their own instruments and other materials. The first year is devoted to freehand drawing, the second and third years to mechanical and topographical drawing. Under mechanical drawing are included plans, elevations, and sections of various engineering and architectural designs.

# THE WORK ACCOMPLISHED.

Part of the work of the Department of Applied Sciences has been the general training of students seeking a liberal culture, candidates for the ordinary bachelor's degrees. It is difficult to measure the amount or excellence of this work. Some estimate of the higher and specialized work can be gained by considering the publications issued, investigations pursued, and the trained men sent out.

BOOKS PUBLISHED.

1882. Key to Newcomb's College Algebra. By J. H. Gore (Columbian University) and J. W. Gore.

1883. A Course in Qualitative Chemical Analysis. By F. P. Venable. University Publishing Co., New York. Four editions, the latest revised by A. S. Wheeler.

1893. Theory of Vaussoir Arches. 2nd Edition. By Wm. Cain. D. Van Nostrand Co., New York.

1894. A Short History of Chemistry. By F. P. Venable. D. C. Heath & Co., Boston. Two editions.

1896. The Development of the Periodic Law. By F. P. Venable. Chemical Publishing Company, Easton, Pa.

1896. School Chemistry. By Charles Baskerville. B. F. Johnson Co., Richmond, Va.

1897. Maximum Stresses in Framed Bridges. 2nd Edition. By Wm. Cain. D. Van Nostrand Co., New York.

1898. Key to School Chemistry. By Charles Baskerville. B. F. Johnson Co., Richmond, Va.

1898. Inorganic Chemistry According to the Periodic Law. By F. P. Venable and J. L. Howe (Washington and Lee University). Chemical Publishing Company, Easton, Pa.

1904. The Study of the Atom. By F. P. Venable. Chemical Publishing Company, Easton, Pa.

1905. Theory of Steel-Concrete Arches and of Vaulted Structures. 4th Edition. By Wm. Cain. D. Van Nostrand Co., New York.

Practical Designing of Retaining Walls. 4th Edition. By Wm. Cain. D. Van Nostrand Co., New York.

A Brief Course in the Calculus. By Wm. Cain. D. Van Nostrand Co., New York.

RESEARCHES AND PAPERS.

1882. Heptylene from Heptane of P. Sabiniana. F. P. Venable. J. Am. Chem. Soc., 1882, 22.

Action of Alcoholic Potash on Heptylene Bromide. F. P. Venable. J. Am. Chem. Soc., 1882, 254.

Analysis of Rock Salt from Saltville, Va. Thomas Radcliffe. J. Am. Chem. Soc., 1882, 255.

Analysis of a Deposit in Blast Furnace at Longdale, Va. Thomas Radcliffe. J. Am. Chem. Soc., 1882, 256.

1883. Heptylmalonic and Heptylacetic Acids. F. P. Venable. J. Am. Chem. Soc. 1883, 10.

Hydrated Carbon Bisulphide. F. P. Venable. Am. Chem. Jour., 1883, 69.

1884. Zinc in Drinking Water. F. P. Venable. Lond. Chem. News, 1884.

Decomposition of Potassium Cyanide. J. F. Wilkes. Mitchell Sci. Soc. J., I., 18.

Action of Ammonium Hydroxide upon Lead Chloride. Julian Wood. Mitchell Sci. Soc. J., I., 24.

Alterability of Amorphous Phosphorus. J. C. Roberts. Mitchell Sci. Soc. J., I., 37.

Action of Ammonium Hydroxide upon Lead Iodide. J. C. Roberts. Mitchell Sci. Soc. J., I., 43.

Attempt at forming Copper Barium Acetate. J. C. Roberts. Mitchell Sci. Soc. J., I., 50.

Solubility of North Carolina Phosphate Rock. J. L. Borden. Mitchell Sci. Soc. J., I., 53.

Rate of Reversion in Superphosphates prepared from Red Navassa Rock. (Thesis for Ph.D.) W. B. Phillips. Mitchell Sci. Soc., J., I., 56.

1885. Analysis of Leaves of Ilex Cassine. F. P. Venable. J. Am. Chem. Soc., 1885.

Occurrence of Citric and Malic Acids in Peanuts. E. A. deSchweinitz. Mitchell Sci. Soc. J., II., 47.

Certain Attractions of Phosphorus. F. P. Venable Mitchell Sci. Soc. J., II., 57.

Some Attempts at forming Heptyl Benzol from Secondary Heptane F. P. Venable. Mitchell Sci. Soc. J., II., 77.

Attempts to form Mercurous Hyphosphite E. A. deSchweinitz. Mitchell Sci. Soc. J., II., 78.

Ammonia in Saliva. Max Jackson. Mitchell Sci. Soc. J., II., 85.

Solubility of Barium Chromate. J. F. Wilkes. Mitchell Sci. Soc. J., II., 90.

1886. A Thermometer for Class Illustration. F. P. Venable. Mitchell Sci. Soc. J., III., 142.

1887. A New Test for Iron. F. P. Venable. J. Anal. Chem., I., No. 3.

A New Form of Bunsen Burner. F. P. Venable. J. Anal. Chem., I., No. 3.

The Limits of the Senses. F. P. Venable. Mitchell Sci. Soc. J., IV. (2), 31.

Some New Salts of Camphoric Acid. I. H. Manning. Mitchell Sci. Soc. J., IV. (1), 52.

The Elements Historically Considered. F. P. Venable. Mitchell Sci. Soc. J., IV. (2), 36.

Decomposition of Potassium Cyanide. I. H. Manning. Mitchell Sci. Soc. J., IV. (1), 54.

Lead Chlor-sulphocyanide. R. G. Grissom. Mitchell Sci. Soc. J., IV. (1), 55.

Solubility of Alumina in Sulphuric Acid. R. G. Grissom. Mitchell Sci. Soc. J., IV. (1), 55.

Action of Chlorous Acid upon Heptylene. R. G. Grissom. Am. Chem. Jour., 1887.

Simple Apparatus for Electrolysis of Water. F. P. Venable. J. Anal. Chem., II., Pt. 1.

1888. Analyses of North Carolina Wines. F. P. Venable and W. B. Phillips. J. Anal. Chem. II., Pt. 1.

A Partial Chemical Examination of Some Species of Genus Ilex. F. P. Venable. Mitchell Sci. Soc. J., V., 128.

More New Salts of Camphoric Acid. G. W. Edwards. Mitchell Sci. Soc. J., V., 8.

New Halogen Compounds of Lead. F. P. Venable and B. Thorp. Am. Chem. J.

The Bromination of Heptane. F. P. Venable. Am. Chem. J.

Changes in Bottled Samples of Acid Phosphate. W. B. Phillips. Mitchell Sci. Soc. J., V., 22.

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POSITIONS FILLED.

1881. *Thomas Radcliffe. Acme Fertilizer Co., Wilmington, N. C.

J. F. Wilkes. Mecklenburg Iron Works, Charlotte, N. C.

F. B Dancy. Assistant State Chemist; Managing Director Old Fertilizer Co., Norfolk, Va.; Division Superintendent Virginia-Carolina Chemical Co., Atlanta, Ga.

H. B. Battle, Ph.D. Assistant State Chemist; Director N. C. Experiment Station; Virginia-Carolina Chemical Co., Montgomery, Ala.

1883. Wm. B. Phillips, Ph. D. Assistant State Chemist; Chemist Navassa Guano Co.; Professor of Metallurgy University of N. C.; Professor of Chemistry, University of Ala.; Chemist Tennessee Coal & Iron Co., Birmingham, Ala.; Associate editor Engineering Journal, N. Y.; Editor American Manufacturer, Pittsburg, Pa.; Professor of Economic Geology, University of Texas.

1884. J. C. Roberts. Professor of Metallurgy, Colorado School of Mines; Superintendent of Mine, Cripple Creek; Reduction Works, Niagara Falls, N. Y.

*E. A. de Schweinitz, Ph.D. Chief of Division of Bio-Chemistry, U. S. Department of Agriculture; Professor of Chemistry and Dean of the Medical School, Columbian University, Washington, D. C.

James Lee Love. Assistant Professor of Mathematics, University of N. C.; Assistant Professor of Mathematics, Harvard University, and Secretary of the Lawrence Scientific School.

1885. W. C. Riddick. Professor of Civil Engineering and Mathematics, North Carolina College of Agriculture and Mechanic Arts.

1886. I. H. Manning. Chemist Navassa Fertilizer Co., Wilmington, N. C.; Chemist Chesapeake Fertilizer Co., Baltimore, Md.; Assistant Surgeon Atlantic Coast Line Railroad; Professor of Physiology, University of North Carolina.

1888. *Benoni Thorp. Assistant State Chemist, Raleigh, N. C.

1889. *H. L. Harris. Assistant, N. C Geological Survey.

1890. W. M. Allen. Assistant State Chemist, Georgia; Assistant State Chemist, Raleigh, N. C.

*H. L. Miller, Assistant in Chemistry, N. C. Agricultural and Mechanical College; Chemist Navassa Fertilizer Co., Wilmington, N. C.; Division Superintendent Virginia-Carolina Chemical Co.

1891. J. M. Morehead. Electrical Engineer, Chicago.

A. H. Patterson. Professor of Physics and Astronomy, University of Georgia.

H. B. Shaw. Instructor in Mathematics, University of North Carolina; Assistant in Electrical Engineering, Lawrence Scientific School, Harvard University; Professor of Electrical Engineering, University of Missouri.

W. L. Spoon. Civil Engineer.

1892. J. V. Lewis. Professor of Geology, Clemson College, S. C.; Professor of Geology, Rutgers College, New Jersey.

1893. DeB. Whitaker. Chemist, Spanish-American Iron Co., Santiago, Cuba.

Charles Baskerville, Ph.D. Professor of Chemistry, University of N. C.; Professor of Chemistry, College of the City of New York.

R. H. Mitchell. Professor of Chemistry, Santa Rosa College, Santa Rosa, Cal.

1894. J. R. Harris. Assistant State Chemist, Raleigh, N. C.; Chief Chemist, Tennessee Coal and Iron Co., Birmingham, Ala.

Chas. H White. Instructor in Mining and Metallurgy, Harvard University.

1895. W. R. Kenan, Jr. Superintendent Carbide Works, Niagara Falls; General Manager Traders' Paper Co., Lockport, N. Y.

Edward W. Myers. U. S. Geological Survey,

1896. Thomas Clarke, Ph D. Assistant Chemist, U. S. Department of Agriculture; Chemist Tennessee Coal and Iron Co., Birmingham, Ala

F. F. Bahnson. Electrical Engineer, Palm Beach, Fla.

Robert E. Coker. N. C. Geological Survey.

E P. Garr. Bureau of Soils, U. S. Department of Agriculture.

1897. S. H. Harris. Chemist, Nicaragua Canal Commission, Greytown, Nicaragua.

A. F. Moses. Chemist, Southern Chemical Co., Winston, N. C.

*B. W. Weston. Superintendent Gold Mine, near Hickory, N. C.

A. W. Mangum, Bureau of Soils, United States Department of Agriculture.

1898. A. W. Belden. Chemist, Tennessee Coal and Iron Co., Birmingham, Ala.

W. G. Haywood. Assistant State Chemist, Raleigh, N. C.

1899. F. W. Miller. Chemist, Northern Alabama Coal, Iron & Railway Co., Talledega, Ala.; Chemist, Birmingham Testing Laboratory.

James E. Latta. Associate Professor of Physics, University of North Carolina.

T. Gilbert Pearson. Professor of Geology and Biology, North Carolina Normal and Industrial College.

R. G. S. Davis. U. S. Geological Survey.

J. P. Bunn. Superintendent Gold Mine, Edgecombe Co., N. C.

1900. J. J. Asbury. Tennessee Coal and Iron Co., Birmingham, Ala.

F. G. Kelly. Tennessee Coal and Iron Co., Birmingham, Ala.

Isaac F. Harris. Research Assistant, Connecticut Experiment Station, New Haven, Conn.

D. M. Swink. Electrical Engineer, Durham Traction Co., Durham, N. C.

N. C. Curtis. U. S. Geological Survey; Instructor in Drawing, University of North Carolina.

George N. Coffey. In charge of Soil Survey, U. S. Department of Agriculture.

T. D. Rice. Bureau of Soils, U. S. Department of Agriculture.

Frank Bennett. Bureau of Soils, U. S. Department of Agriculture.

W. E. Hearn. Bureau of Soils, U. S. Department of Agriculture.

L. V. Branch. U. S. Geological Survey.

1901. B. G. Klugh. U. S. Steel Corporation, Eveleth, Minn.

J. E. Mills, Ph.D. Instructor in Physical Chemistry, University of N. C.; Manager Standard Turpentine Co., Camden, S. C; Associate Professor of Chemistry, University of North Carolina.

R. O. E. Davis, Ph.D. Instructor in Chemistry, University of N. C.

Aldert S. Root. Bureau of Soils, U. S. Department of Agriculture.

1902. F. H. Lemly. Bio-chemical laboratory, U. S. Department of Agriculture.

Warren L. Kluttz. Tennessee Coal and Iron Co., Ensley, Ala.

J. W. Turrentine, Instructor in Chemistry, Lafayette College, Easton, Pa.

Willis O Heard, Central Laboratory, Chester, Pa.

D. Z Cauble, Tennessee Coal and Iron Co., Bessemer City, Ala.

E. G. Moss, Chemist, Cumberland Furnace, Tenn.

W. S. Prior, Jr., Tennessee Coal and Iron Co., Ensley, Ala.

M. H. Stacy. Instructor in Mathematics, University of North Carolina.

John S. Henderson, Jr. Electrical Engineer with Westinghouse Co., Pittsburg, Pa.

B. S. Drane, U. S. Geological Survey.

T. C. Oliver. U. S. Geological Survey.

J. L. Burgess. Bureau of Soils, U. S. Department of Agriculture.

J. J. Skinner. Bureau of Soils, U. S. Department of Agriculture.

1903. H. H. Bennett. Chemical Department, Soil Survey, U. S. Department of Agriculture.

Thos. B. Foust. Bon Air Coal and Iron Co., Allen's Creek, Tenn.

H. R. Weller. Garrett Wine Company, St. Louis, Mo.

Hazel Holland. Assistant Chemist, Welsbach Lighting Co., Gloucester City, N. J.

Reston Stevenson. Assistant in Chemistry, Cornell University.

J. B. Thorpe. Clairton Steel Co., Clairton, Pa.

Geo. F. Catlett. Assistant State Chemist, Raleigh, N. C.

R. A. Litchtenthaler. Instructor in Chemistry, University of Florida.

F. L. Foust. U. S. Geological Survey.

Burges Urquhart. U. S. Geological Survey.

E. R. Wainwright. Canada Geological Survey.

Harllee McCall. Instructor in Mathematics, North Carolina College of Agriculture and Mechanic Arts.

1904. L. B. Lockhart. Instructor in Chemistry, Pensacola Academy, Fla.

John H. Pearson. With General Electric Co., Schenectady, N. Y.

N. R. Graham. Assistant in Chemistry, College of the City of New York.

S. S. Heide. Chemist, Bon Air Coal and Iron Co., Allen's Creek, Tenn.

Preston Irwin. Chemist, Toch Bros., Paint Manufacturers, N. Y.

W. McK. Marriott. Assistant in Chemistry, Cornell Medical School, N. Y.

1905. E. E. Randolph. Carnegie Assistant in Chemistry, College of the City of New York.

Stroud Jordan. Carnegie Assistant in Chemistry, College of the City of N. Y.

Rex W. Perry. Assistant Chemist, Cotton Oil Works, Memphis.

Wade H. Oldham. Assistant Chemist, Tennessee Coal and Iron Co., Ensley, Ala.

Ernest Sifford. Assistant Chemist, Tennessee Coal & Iron Co., Ensley, Ala.

R. G. Lassiter. General Manager Pontiac Mining Co., Va.

George M. MacNider. Soil Work with North Carolina Department of Agriculture.

Hamilton M. Jones. With Westinghouse Co., Pittsburg, Pa.